How Safe Is Your Safelight?

Two simple, reliable tests with surprising results

We want our photographic paper to be sensitive to light, but we do not like to be in complete darkness when we work with it. The photo industry has a solution for this contradiction.

Photographic paper is only sensitive to a certain range of the visible spectrum. In addition, safelight filters transmit only light from a different range of the visible spectrum. This way, our eyes and the paper are sensitive to the light projected by the enlarger, but only our eyes and not the paper are sensitive to the light illuminating the darkroom.

Fig.1 shows how sensitive variable-contrast (VC) papers are to blue and green light, which require a safelight output limited to wavelengths above 560 nm, in order to protect the paper from unwanted exposure. Kodak's 'light red' (1A) and 'light amber' (OC), or Ilford's 902 and 904 safelight filters fulfill this requirement. Filter 1A provides more protection, because it only transmits wavelengths above 600 nm, but the eye is not particularly sensitive to this light, and consequently, this filter makes for a rather dim darkroom environment. The OC filter, on the other hand, transmits light in wavelengths very close to the human peak sensitivity, providing a much brighter workplace and softer illumination. Both filters are sold as being 'safe', because they do not emit any light to which typical papers have any significant sensitivity.

Unfortunately, this is not entirely true for several reasons. First, the papers are not totally insensitive, but have a very low sensitivity outside the intended spectrum. Second, the safelight filters transmit minute levels of light outside their intended spectrum, and this effect increases with their age. Third, the safelight housing, depending on design and quality, may have some minor, unintended light leaks.

This requires that we rephrase the statement about safelights. Safelights protect photographic paper only for a limited amount of time, after which non-image forming exposure becomes visible. Consequently, we need to know how long the paper is protected, and how to test the safelight condition reliably.

Paper Characteristics

You can see in fig.2 how photographic paper responds to the light it was designed for. The paper characteristic curve represents density levels achieved by any given amount of exposure.

Initially, illustrated through the shallow ramp up at the toe of the curve, a small amount of exposure is required just to get the paper 'started'. Minute amounts of light leave the paper unaffected until a moderate amount achieves the 'first usable density'. The human eye is most discriminating to the small differences in density in these highlight areas.

The paper, on the other hand, is most sensitive in the midsection of the curve, where even small exposure changes result in significantly different densities. In the shoulder of the curve, a certain density saturation has taken place, and additional exposure add relatively small density increases until a maximum black has been reached. The human eye is not particularly sensitive in these shadow areas, and is unable to see density differences after a certain point, which is referred to as the 'last usable density'.

Image Exposure

The paper characteristic curve in fig.2 also illustrates that small amounts of exposure, similar to typical safelight illuminations, do not harm unexposed paper, because this limited exposure cannot overcome the initial inertia of sensitivity. A certain amount of light is first required to get beyond the horizontal portion of the toe. In a typical darkroom session, this hurdle is taken when an exposure is made to get the brightest tonal values of the image to the point of the 'first usable density'. This exposure sensitizes the paper to any further illumination. From this point on, even small amounts of exposure will increase density in all tonal values, but most visibly in the highlights. Safelight illumination, both before and after this image forming exposure, can only be tolerated for a certain length of time, after which a density increase visible to the human eye results. We will try to duplicate these conditions to design a practical and representative safelight test.

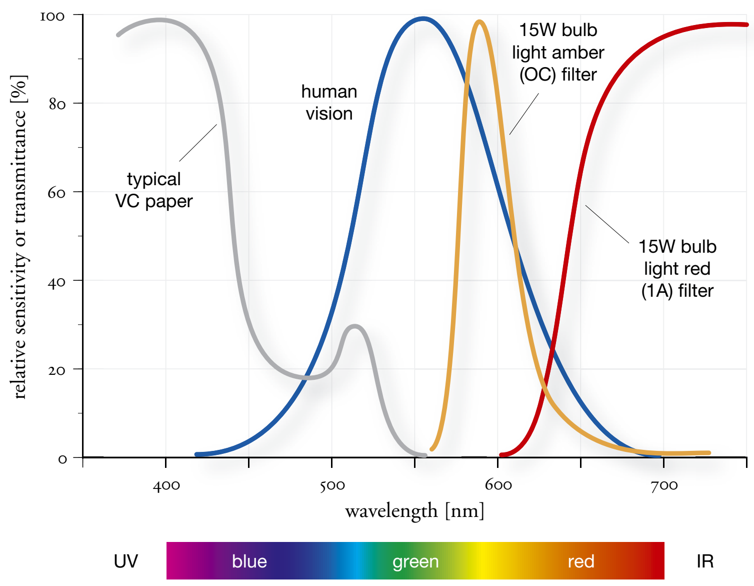

fig.1 Incandescent illumination in combination with light amber (OC) or light red (1A) filtration protects the paper against fogging for several minutes, because it does not emit any significant radiation to which the paper is sensitive. However, amber filters provide more visible radiation than red filters, creating a much brighter environment in the darkroom.

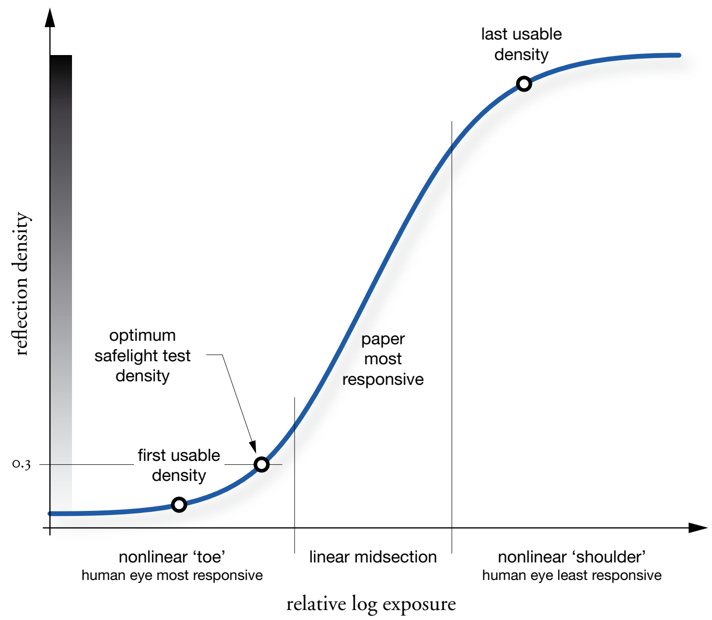

fig.2 The paper characteristic curve shows how paper densities increase with exposure. Initially, however, minute amounts of light leave the paper unaffected.

Safelights protect photographic paper only for a limited amount of time, after which non-image forming exposure becomes visible.

Typical variable-contrast papers are appropriately protected with a light-amber (OC) safelight filter, but some papers need the stronger protection of a light-red (1A) filter. Fast orthochromatically sensitized papers need the strongest protection and require a dark-red (2) filter.

Simulating Image Exposure

The image exposure through the negative is best simulated with the 'optimum safelight test density'. This is a good compromise between the 'first usable density' (Zone VIII), where the eye is most sensitive to density changes, and the 'linear midsection' (Zone V), where the paper is most responsive to exposure increases.

In total darkness and without film in the negative carrier, produce a test strip on 'normal' graded paper, to find the enlarger exposure required to produce the 'optimum safelight test density'. This is a light gray tonal value between Zone VI and Zone VII, or about 0.3 reflection density. A high degree of accuracy is not required at this point. Use a step tablet, a zone ruler, or print it just a little darker than you typically print your textured highlights.

A Precise Test

You will need a single sheet of 8x10-inch paper and two thick pieces of cardboard. One piece, the mask, requires a 4x8-inch cutout, and the other piece is needed to cover the test strips. Trim one corner of the mask, because this will aid in the orientation of the paper. Make sure that all processing chemicals are prepared. A 'normal' filter is placed into the light path and the lens is set to an aperture that, in combination with the proper exposure time, will produce the 'optimum safelight test density'. Place an empty tray on top of the development tray, which will be required later as a physical support for the paper.

The following steps can be executed in any order, since the exposures are accumulative. Customize all times to simulate your own work habits.

1. On the Baseboard

In the dark, center the paper on the baseboard and cover it with the mask. Turn the safelight on. Immediately cover the first horizontal step, about 1 inch, and continue to cover more steps resulting in a practical pre-exposure sequence that reflects your own work habits. I usually simulate pre-exposure paper handling from 0-16 minutes in intervals as shown in the examples. As an optional step, you could turn the enlarger 'on' for the first 2 or 3 minutes of the pre-exposure, while shading the paper with one of your dodging or burning tools. This tests for any light leaks from the enlarger and/or reflections from the surrounding walls. Turn the safelight off.

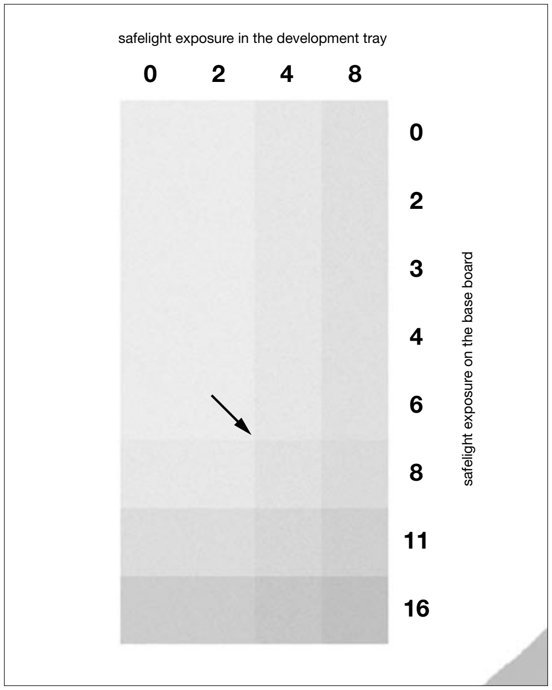

fig.3 (right) This safelight allows for 6-minute paper handling on the baseboard but only 2 minutes in the development tray, a performance hardly worthy of being referred to as 'safe'.

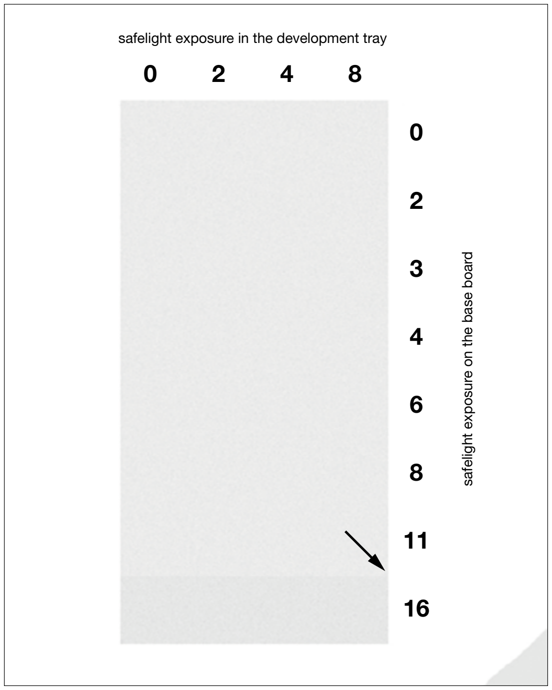

fig.4 (far right) This safelight allows for 11-minute paper handling on the baseboard and 8 minutes or more in the development tray. This is fully adequate for most printing sessions.

2. Exposing the Print

While still in the dark, turn the enlarger on to expose the paper for the 'optimum safelight test density'. This simulates the image exposure and was pretested earlier. Leave the safelight off.

3. In the Developing Tray

Again in the dark, place the paper with the mask on top of the development tray. Turn the safelight on. Immediately cover the first vertical step, about 1 inch, and continue to cover step by step creating a practical post exposure sequence, reflecting your own work habits. I usually simulate post exposure paper handling, including the development process, from 0-8 minutes in intervals as shown in the examples. Some printers ignore this step, because they believe that paper loses its sensitivity to light as soon as it becomes wet. I have found no evidence for this claim. Finish the test by processing the paper normally in the dark.

Test Evaluation

Three possible results are shown in the test print examples. Keep in mind that the top left patch, which we will refer to by its coordinates 0-0, has not been exposed to any safelight, but was sensitized, simulating print exposure, in step 2.

The first example, see fig.3, was exposed to two different safelights, one close to the enlarger and the other above the development tray. The test shows a very poor safelight performance. The last patch matching the gray value of the top left corner is patch 2-6. This means this paper should not be exposed to the safelight conditions around the baseboard for any longer than 6 minutes. The safelight conditions at the development tray allow for an additional exposure of no more than 2 minutes. The baseboard time could be adequate, if no special paper handling were required, but the time in the development tray is too short for even the processing of resin-coated papers. The owner of this darkroom should check all safelights, but the light near the development tray needs to be replaced or checked for light leaks.

The second example, see fig.4, was exposed to the same safelights after bulbs and filters were replaced, and a small light leak in one of the housings was taped over. The test shows a very good safelight performance. The last patch matching the gray value of the top left corner is patch 8-11. This means that the paper can be exposed to the safelight conditions around the baseboard for about 11 minutes. The safelight conditions around the development tray allow for an additional exposure of at least 8 minutes. The baseboard time is long enough for most paper handling, and the time in the development tray is adequate for the processing of fiber-base papers. The owner of this darkroom can trust the safelights unless special processes, like lith printing, requiring long times in the development tray are used. In that case, the test times have to be modified to reflect the special requirements.

The third example, fig.5, was exposed with the same safelights as in the previous example, with one addition. The enlarger was 'on' during the first 3 minutes of the pre-exposure, while the paper was shaded with a burning card. The test shows a very good safelight performance, but enlarger light leaks and reflections have reduced this to less than 2 minutes.

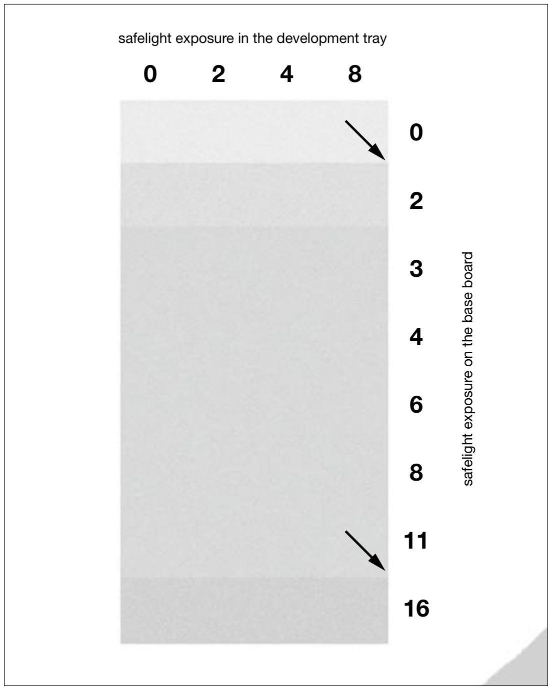

fig.5 Here the enlarger was 'on' during the first 3 minutes of the pre-exposure, while the paper was shaded with a burning card. The safelights protect as in fig.4, but enlarger light leaks and reflections fog the paper in less than 2 minutes.

The last patch matching the gray value of the top left corner is patch 8-0 and no further change can be seen until patch 8-11. This means that the paper can only be exposed to the safelight conditions around the baseboard for less than 2 minutes. The safelight conditions around the development tray allow for an additional exposure of at least 8 minutes. The time in the development tray is adequate, but the baseboard time is too short for real world paper handling. The owner of this darkroom must make several changes to the darkroom. Suggestions would include the following steps. The walls around the enlarger should be painted flat black. The enlarger itself should be checked for light leaks and reflections. Confirm that cards, used for dodging and burning, do not transmit any light to the print. The printer should also wear dark clothing to reduce reflections.

This valuable test can be performed in about 30 minutes, and I repeat it every 3 to 6 months, just to be sure. It is a great assurance to know that the safelights are not affecting print highlights and image quality during normal processing times.

The Coin Test

The previous test clearly identifies any source of light contamination and quickly points to the area that requires improvement. The coin test is not quite that sophisticated and does not discriminate between different sources of light contamination, but properly executed, it is a reliable check and is easily done.

1. In the dark, pre-expose a sheet of paper, so it will produce a light-gray density, once it is processed.
2. Still in the dark, put the paper on the work surface, right under your safelight, and randomly distribute six coins on the paper, as seen in fig.6.
3. Now, turn the safelight(s) on, and after 1 minute, remove the first coin.
4. Remove the other coins after a total of 2, 4, 8 and 16 minutes, but do not remove the last coin.
5. After 32 minutes, turn off all safelights, remove the last coin, and process the paper normally.

Depending on how 'safe' your safelight illumination is, the coins will have left more or less ghostly evidence about their previous positions on the paper. After this quick test, you will have a pretty good idea of how long you can work under the safelights, without adding unwanted fog to your print's highlights.

The test example in fig.6a illustrates the effect of a poor safelight protection. With the exception of the 1-minute coin, all coins have left their telltale signs. This indicates that the safelight illumination is, unfortunately, strong enough to affect the print's highlights in less than two minutes.

The test example in fig.6b, on the other hand, indicates a fully adequate safelight protection. The only still-visible remnant is the shape of the coin that covered the paper for 32 minutes. This safelight can be trusted to protect delicate print highlights for at least 16 minutes and maybe longer.

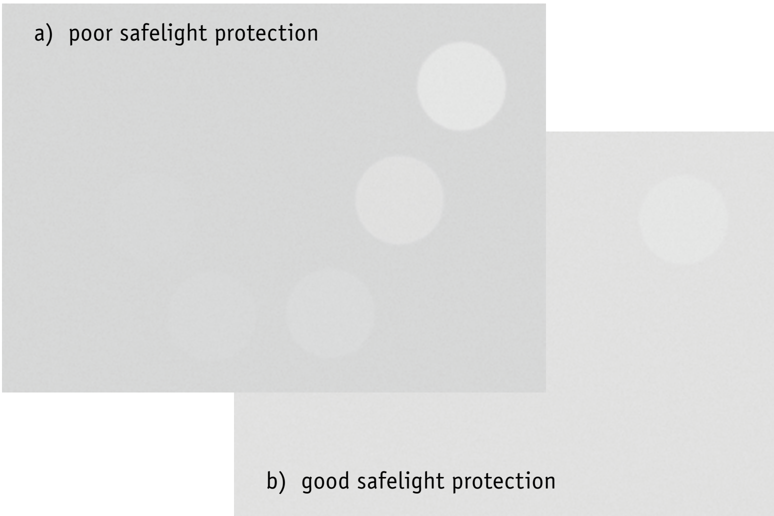

fig.6 The coin test is not as sophisticated as a precise safelight test, but it is a reliable check and is easily executed.